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SAMBUCUS PUBENS VAR. XANTHOCARPA.[1]

BY JAMES J. LYNCH.

The species *Sambucus pubens* was first recognized as distinct from the European *Sambucus racemosa*[2] by Michaux,[3] but Britton[4] identifies it with *Sambucus racemosa* of Europe. The new variety *xanthocarpa* was found by Nieuwland (2) and showed sufficient differences from *Sambucus pubens* and *Sambucus racemosa,* and this will here be considered for study.

HABIT OF THE SEEDLING.

The young seedlings were grown indoors and seemed to thrive easily under ordinary cultivation. The seeds are ovoid in shape, channelled and have minute transverse linear markings. In the germination of the seed the embryo breaks through the seed coat very close to the scars and primary root and hypocotyl emerge in succession. (Fig. 1). The cotyledons are ovate to spatulate in shape and the petiole is ridged longitudinally on its inner side. The primary root goes down to a length of about one and a half centimeters from a more or less prolonged hypocotyl and is covered by numerous root hairs. Upon further development of the epicotyl there appear two or three simple serrate leaves, broadly ovate to cordate. (Fig. 2.) The formation of stem and the increase of leaf development occurs in usual way of dicotyledons. (Fig. 13.) The later leaves, however, become more and more typically pinnate. The first are trifoliolate with small ovate side leaflets and a large apical one. Transition stages are found between simple and compound leaves. The simple

[1] Part of thesis offered as partial requirment for degree of B. S. in Biol.

[2] Linnaeus, C., Species Plantarum, 270 (1753).

[3] Michaux, A., Flora Bor. Americana I. 181 (1803).

[4] Nieuwland, J. A., Am. Mid. Nat. III., 310 (1914).

leaflets have a tendency of unequalization of halves, but especially it is the apical leaflet that is inequilateral.

Anatomy of the Seedling.

The primary root has a single radial woodbundle that continues partly through the hypocotyl and gives off two branches for the petioles of the cotyledons. The main part continues into the epicotyl and from this collaterals are given to the leaf petioles as soon as they appear. The stele of the hypocotyl in cross section is diarch exarch.

Primary Root. (Fig. 3).

A cross section of the pirmary root shows the woodbundle to be radial, diarch and with apparently a continuous strand of xylem (Xy) having phloem on both sides (Ph). The growth of xylem is exarch and the ducts are spiral and annular. The endodermis (En) is regular and clearly differentiated by the size of cells. In shape the cells are in no way different from the surrounding cortex but do not have Casparyan spots, a common peculiarity of this tissue. In very young plants the periblem (CP) is composed of about four layers of cells which increase in size outwards and merge into a series of more or less flattened cells which constitute the hypodermis (Hy). The epiblema (Ep) cells are thick walled on their outer side and are more palisaded in shape than those lying below them.

Epicotyl (Figs. 4, 5, 6.)

The section illustrated in this figure (Fig. 4) is a very young stage and cut close to the root. The stele like that of the root is diarch exarch and the cells of the pith are very irregular in shape. The stele is present in the middle of the pericycle and this has an endodermis not well defined. The cortical parenchyma of about four layers shows an irregular structure in the size of its cells. A distinctive hypodermis is lacking altogether and the outer layer (Ep) consists of smaller thicker cells than the underlying parenchyma.

A cross section of an older seedling (Fig. 5) shows the changes which occur in the hypocotyl due to later growth. The proto- and meta-phloem (Ph) have been pushed out by the formation of cambium (Ca) which now surrounds the xylem (Xy) and is itself enclosed by the secondary phloem. The development of xylem is irregular and lateral to the proto- and meta-phloem.

The endodermis (En) is quite regular and clearly distinct from the cortical cells around it. The cortical parenchyma cells are round in outline of cross section and the hypodermis is very distinct.

A cross section of the hypocotyl (Fig. 6) shows the stele nearly filled with xylem (Xy). The secondary xylem pushes out the cambium (Ca) and this then constitutes four layers of cells. The phloem (Ph) encircles the xylem which completely fills the inner part of the stele, there by showing the absence of pith. The xylem is fully developed. The cross section was made from a point high up the length of the stem.

Cotyledon and its Petiole. (Fig. 9).

As a general rule the cotyledon is notched at its apex and has one closed collateral wood bundle with xylem (Xy) to the upper and phloem (Ph) to the lower side. Chlorenchyma is found in the intervening space between the stele and epidermis (Ep). A distinct hypodermis (Hy) is present just below the epidermis. The petiole of the cotyledon is in no way different from that of the leaf, which will be discussed later.

The upper and lower epidermis (Fig. 7) of the cotyledon have about the same structure. The cells are very irregular in shape and the stomata contain chlorophyll grains and are more numerous upon the ventral face than upon the dorsal surface. Intercellular spaces (IS) are found interposed between the cells of the chlorenchyma (Fig. 8).

Epicotyl (Fig. 10).

The epicotyl in early growth soon has about twelve collateral woodbundles, two of which are shown in the illustration. Three layers of cells constituting the cambium (Ca) and very little differentiated from the phloem (Ph) in size and shape, are interposed between the xylem (Xy) and phloem. Wood parenchyma cells are interspersed bettween the cells of xylem. The pith (Pi) consists of cells of regular outline. The parenchmya (Pa) is composed of cells of irregular size. A hypodermis (Hy) is found beneath the epidermis (Ep) which apparently consists of two layers, the outer layer of which is not very much thickened as is usually the case.

Petiole of the Leaf. (Fig. 11).

The cross section of the petiole of the leaf is circular in out-

line and has three closed collateral woodbundles. The xylem (Xy) is inward and the phloem (Ph) outward. Cortical parenchyma occupies the intervening space between the stele and the epidermis and a distinctive hypodermis (Hy) does not exist. The epidermis (Ep) is composed of cells longer than broad with a thickened cuticle.

The Leaf. (Fig. 12).

The epidermis of the leaf, dorsal as well as ventral is composed of cells not unlike those of the cotyledon and in general has the same appearance. The cells are flattened and diminish in chlorophyll content towards the outside. There are large intercellular spaces between the chlorenchyma cells. The epidermis (Ep) shows a greater thickening in its walls than in those of the adjoining cells.

Conclusion.

1. Pith is absent in the primary root and hypocotyl of the young seedling,but is present in the upper part of the hypocotyl and epicotyl.

2. The plant at first produces simple leaves but by a series of transitional stages compound leaves are formed, the apical leaf being the largest.

3. As the lower part of the hypocotyl matures the entire center of the stele is filled with xylem and no pith is to be found.

Explanation of the Figures.

Fig. 1. Seedling showing the emergence of root, hypocotyl, and cotyledons from the seed.

Fig. 2. A more advanced stage of the seedling showing the cotyledons, hypocotyl, root and two young leaves.

Fig. 3. Cross section of the primary root. (Ep) Epidermis, (Hy) Hypocotyl, (CP) Fundamental parenchyma, (En) Endodermis, (Pi) Pith, (Xy) Xylem (Hadrome), (Ph) Phloem (Leptome).

Fig. 4. Cross section of a very young hypocotyl. (Ep) Epidermis, (CP) Cortical parenchyma, (En) Endodermis, (Xy) Xylem, (Pe) Pericycle, (Ph) Phloem.

Fig. 5. Cross section of hypocotyl. More advanced stage than the preceding. (Ep) Epidermis, (Hy) Hypodermis, (Pa) Extrastelar Parenchyma, (En) Endodermis, (Ph) Phloem, (Ca) Cambian, (Xy) Xylem.

Fig. 6. Cross section of hypocotyl, showing still further development. Wood bundle alone is illustrated. (Pa) Parenchyma, (Ca) Cambium, (Xy) Xylem, (Ph) Phloem.

Fig. 7. Surface view of ventral epidermis of cotyledon. Illustration

shows stomata with companion cells and the adjoining cells of the epidermis.

Fig. 8. Section of chlorenchyma in cotyledon. (IS) Intercellular space. (Cl) Chlorenchyma proper.

Fig. 9. Cross section of a cotyledon. (Ep) Upper epidermis, (EP) Lower epidermis, (Hy) Hypodermis, (Cl) Chlorenchyma, (Xy) Xylem, (Ph) Phloem.

Fig. 10. Cross section of epicotyl. (Ep) Epidermis, (Hy) Hypodermis, (Pa) Parenchyman, (Ph) Phloem, (Ca) Cambian layer, (Xy) Xylem, (Pi) Pith.

Fig. 11. Cross section of the petiole of one of the first leaves. (Ep) Epidermis, (Hy) Hypodermis, (Pa) Parenchyma, (Xy) Xylem, (Ph) Phloem.

Fig. 12. Cross section of an early leaf. (Ep) Upper epidermis, (Ep) Lower Epidermis, (CI) Chlorenchyma, (Is) Intercellular Space, (St) Sotma, (Xy) Xylem, (Ph) Phloem.

Fig. 13. An advanced stage of seedling growth.

THE NAIADES OF MISSOURI.—III.

BY WILLIAM I. UTTERBACK.

Rotundaria granifera (Lea).

("Purple Warty Back," "Purple Pit.")

Pl. XIX, Figs. 55 A and B.

1838—*Unio graniferus* Lea, Tr. Am. Phil. Soc., Vi, p. 69, Pl. XIX, fig. 60.
1900b—*Quadrula granifera* (Lea) Simpson, Proc. U. S. Nat. Mus., XXII, p. 795.

ANIMAL CHARACTERS.

NUTRITIVE STRUCTURES:—Identical with those of *R. tuberculata* in all respects.

REPRODUCTIVE STRUCTURES:—Typical specimens from the Mississippi show the outer gills marsupial; conglutinates same color and form as those of *R. tuberculata;* glochidium measures 0.290 x 0.350mm., being a little larger with more of an undulated hinge line, but with the same general form.

SHELL CHARACTERS

EXTERNAL STRUCTURES:—Like *R. tuberculata* except smaller rotund, upright, alated, inflated,—especially fuller, higher, more antero-protruding beaks and with more of a rayed character of epidermis on anterior umbonal slope. Interior of shell identical

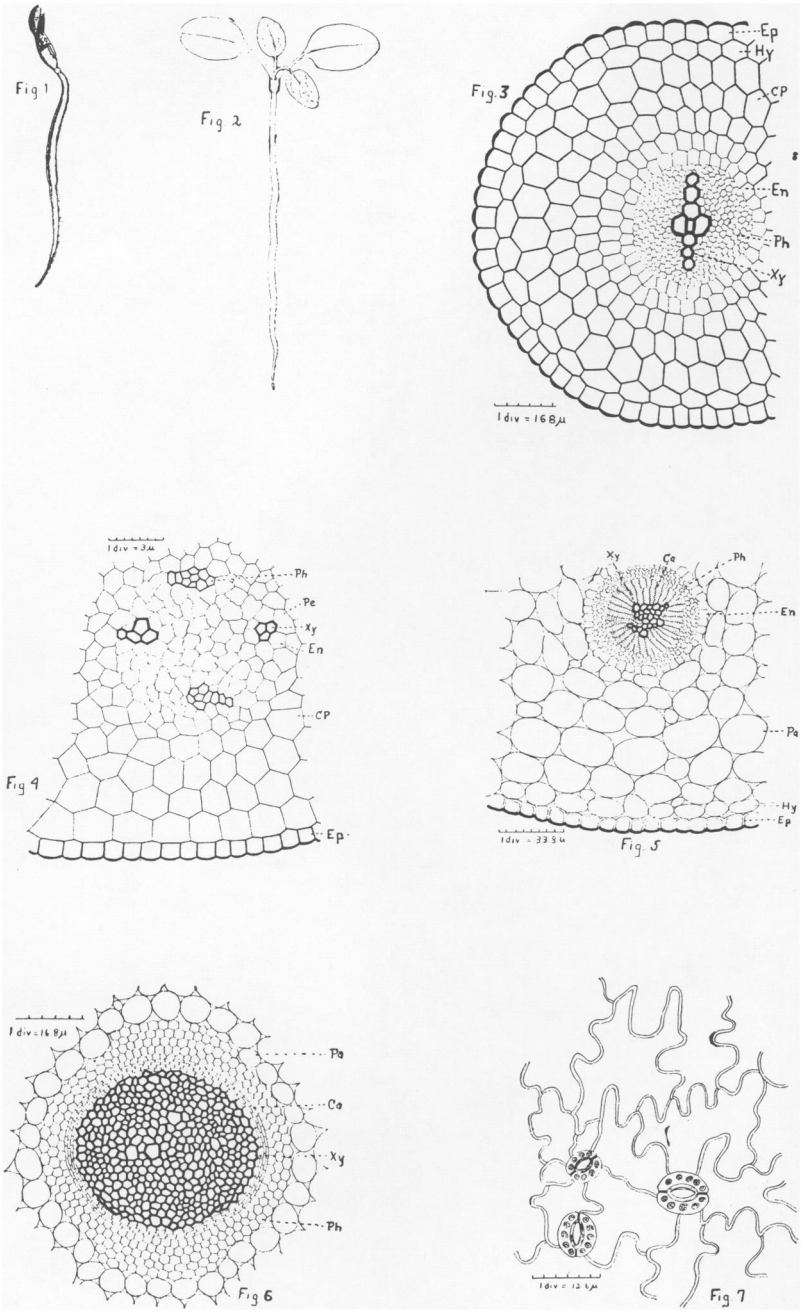

PLATE XI. LYNCH ON SAMBUCUS PUBENS VAR. XANTHOCARPA.

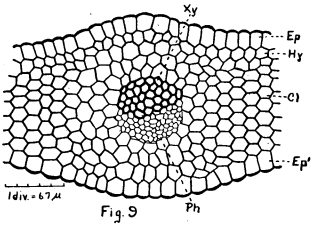

Fig. 9

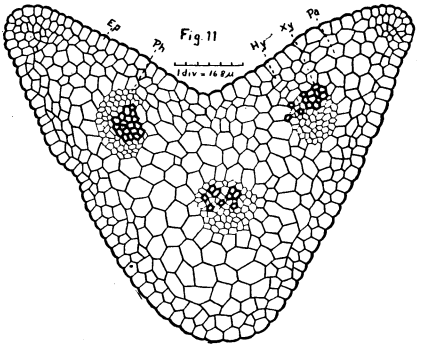

Fig. 11

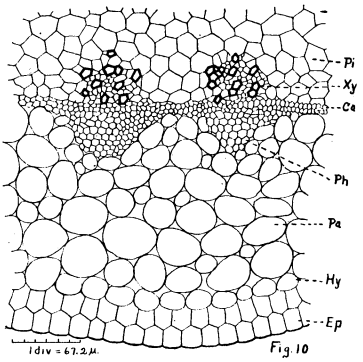

Fig. 10

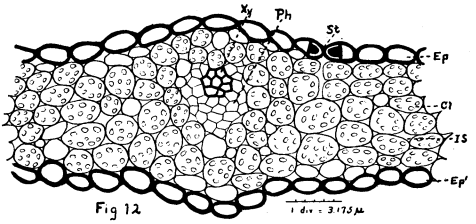

Fig. 12

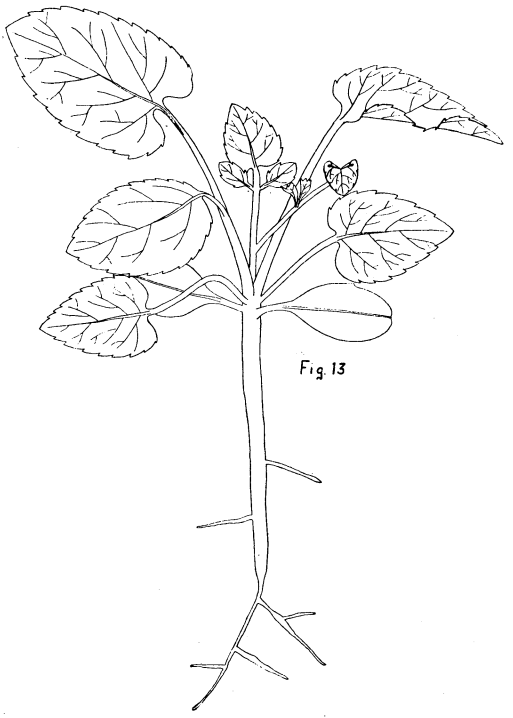
Fig. 13

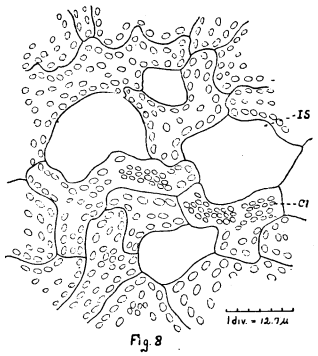

Fig. 8

PLATE XII. LYNCH ON SAMBUCUS PUBENS VAR. XANTHOCARPA.